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State of California
Department of Public Works
Division of Highways
Materials and Research Department

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Mr. Anson Boyd
State Architect
Division of Architecture
Sacramento, California

Attention: Mr. Aldo Crestetto, Civil Engineering Supervisor

Dear Sir:

Submitted for your consideration is:

A REPORT OF

A PRELIMINARY CORROSION SURVEY

AT THE PROPOSED SONOMA STATE COLLEGE

Study made by . . . . . Structural Materials Section
Under general direction of . . . . . J. L. Beaton
Work supervised by . . . . . R. F. Stratfull
Report prepared by . . . . . R. F. Stratfull, W. S. Maxwell and G. R. Steffens

Very truly yours,

F. N. Hveem
Materials and Research Engineer

By J. L. Beaton
Supervising Highway Engineer

61-24

RFS/WSM/GRS
cc: OEAnderson
ISchultz

I. INTRODUCTION

On September 27, 1960, Mr. Aldo Crestetto, Civil Engineering Supervisor, Division of Architecture, requested by letter that the Materials and Research Department perform a soil resistivity survey at the proposed site of the Sonoma State College at Cotati, California.

It was requested that a corrosion survey be made for the purpose of protecting underground utilities from accelerated corrosion at the proposed site.

On June 27, 1961, representatives of the Materials and Research Department performed the preliminary corrosion survey, and the results are included in this report.

II. SUMMARY AND CONCLUSIONS

The soil at the proposed site was found to be a corrosive clay. It is estimated that a 3/4" bare steel pipe will be perforated by corrosion in this soil in approximately 10 years.

It is recommended that cathodic protection be applied to the underground pipe at the time of the construction of the facility.

III. RECOMMENDATIONS

1. That cathodic protection be applied to the underground pipe at the time of the construction of the facility.

2. All steel pipe placed underground shall be coated in accordance with the Standard Specifications for mechanical work dated 1960, Division of Architecture.

3. All steel pipe placed underground shall be electrically continuous and electrically bonded together at designated locations by a pipe connection or an AWG No. 2/0 TW jumper wire.

4. All underground steel pipe that makes an egress into any building shall be electrically insulated from any reinforcing steel or other metals within the structure.

5. Where steel pipe enters a building by means of a riser pipe that is atmospherically exposed, an electrical insulating device shall be placed in the section of pipe that is exposed to the atmosphere. This location will be prior to the entry of the pipe through the building wall or floor.

6. At the locations where buried steel pipe enters a building, the following shall apply:

   A. The wall, footing or slab shall contain a non-metallic pipe sleeve as described in Section 2M, Article 2M-22-d of the standard specifications for mechanical work.

   B. Within six (6) inches of a floor or wall of the structure (inside of such structure) an electrical insulating device shall be placed in the pipe. A warning sign in the form of a copper bearing metal tag shall be labeled, "Do not electrically bond across this fitting", and shall be attached to the pipe where the insulating device is installed.

7. Steel pipe which is to be installed beneath concrete slabs shall be more than 12" distant from the slab except at locations where the pipe rises to enter a building or other structure.

8. All electrical insulating devices that are installed in underground pipe shall contain wires that are attached to the pipe so that its continued performance may be checked without excavation.

9. At all locations that steel pipes cross, but are not in mechanical contact, a jumper wire shall be installed to electrically bond the pipes.

10. Where steel pipes are placed within 5 feet of each other and are on a parallel alignment, a jumper wire shall be installed at a minimum distance of 1000 feet to electrically connect the pipes.

11. The joints of cast iron pipe shall be so constructed that each length of pipe shall be electrically insulated from its adjacent section.

12. All underground electrical conduit is to be made of non-metallic materials.

13. All underground telephone cables shall be coated with a reinforced neoprene jacket.

14. All underground conduit shall be free-draining so as to prevent standing water.

15. Calcium chloride or chloride containing additives shall not be used in concrete containing reinforcing steel or radiant heating systems.

16. Within 30 days of the time that the contract for construction is let, the contractor shall notify in writing all major utility companies in the area of the State's intentions to cathodically protect the underground pipe.

17. Electrical insulating couplings shall be placed in the piping at the following locations:

    A. At all connections between State piping and those of private utilities.

    B. At all connections of steel pipe to other pipes or underground facilities made of dissimilar metals. Steel embedded within concrete is considered a dissimilar metal.

18. No piping placed in the same excavations shall lie across or otherwise be in mechanical or electrical contact with other pipe except at designated locations.

19. Where mechanically feasible, use non-metallic pipe.

20. Do not ground the electrical system to any underground pipe.

21. All electrical wires that are within underground conduit shall have a TW coating or equal.

IV. TESTS

A. Water

A sample of water that could be used at the facility was obtained adjacent to the site. The result of a chemical analysis of the water is as follows:

Anions

Chloride (Cl)	40 PPM
Sulfates (SO_4)	25 PPM

Determinations

Total alkalinity as $CaCO_3$	125 PPM
Calcium as $CaCO_3$	130 PPM
Total solids @ 105° C	350 PPM
(Hydrogen Ion Conc.) pH	7.6
Resistivity (ohm-cm)	2500

From a calculation based upon the Langliar Index, it is expected that the water is sufficiently hard to form a calcium carbonate scale on the inside of the pipe.

From an empirical corrosion test, it is estimated that a 3/4" steel pipe could be perforated by internal corrosion of the pipe in approximately 35 years.

B. Soil

The soil resistivity measurements of the site are plotted on Exhibit I, Equi-Resistivity Contour Plan. As will be noted on Exhibit I, the soil resistivity ranged from 600 to 6,000 ohm-cm. The average electrical resistivity of the soil at the project site was 1500 ohm-cm.

Laboratory tests were performed on soil samples obtained from various locations throughout the proposed site. The results of these tests are as follows: (1) the resistivity varied from 1000 ohm-cm to 1700 ohm-cm and (2) the pH of the soil varied from 6.1 to 6.3.

These tests indicate that the soil is highly corrosive to steel pipe.

V. CORROSION CONTROL

The cathodic protection of the underground facilities can be accomplished in the following manner:

Phase I

Upon the installation of the underground pipe at the proposed Sonoma State College site, tests should be performed to determine the feasibility of using galvanic or impressed currents for corrosion control. Design of the cathodic protection system should be based upon field tests of the existing facilities.

(A preliminary cost estimate of the cathodic protection facilities can be made when working drawings are available. However, the actual design of the system will require a field test of the in-place facilities.)

Phase II

Install required cathodic protection facilities.